LBNL SAFETY REVIEW COMMITTEE

Triennial Review of the Management of Environment, Safety, and Health

Engineering Division

July 2007

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Triennial Review of the Engineering Division
Management of Environment, Safety, and Health (MESH)

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A. Executive Summary

The Engineering Division (Engineering) strives to instill safety as a core value. They do so by emphasizing personal responsibility for safety and supporting employees in their performance of work in a manner consistent with Integrated Safety Management (ISM). Since its reorganization and following the last MESH Review in 2004, Engineering has implemented division-wide enhancements to its safety systems, including development and dissemination of the ISM badge, on-line ISM training, Basic Safety Expectations, and electrical safety training for all Engineering employees. They have also staffed a second division safety coordinator position, creating depth in this critical function and fostering succession planning.

Engineering's leadership team is strongly committed to safety, and is challenged with a heavily matrixed and geographically dispersed work force. To address these challenges, Engineering has adopted a model for safety communications unique to its division. The Division Director leads regular, approximately monthly, "safety headlights" meetings to discuss safety issues. The three Division Deputy Directors, two safety coordinators, human resources manager and an administrative professional all attend the "safety headlights" meetings. The Division Director and Deputies routinely take responsibility for safety issues and see through to completion. The Engineering Division safety coordinators and other staff participate in safety committees of the divisions' major partners Advanced Light Source (ALS) and Accelerator Fusion Research Division (AFRD).

This MESH Review notes 6 noteworthy practices, 5 observations, and 2 concerns. Engineering's application of the Regulations and Procedures Manual (RPM) to responsibilities for safety in matrix situations is inadequate in some areas and warrants further attention by the division.

B. Description of Division

The primary purpose of the Engineering Division is to design, engineer, build, test, maintain, and enhance the unique and innovative scientific apparatus essential to advance scientific research and discovery. Engineering is comprised of three departments, each managed by a division deputy - Electronics, Software and Instrumentation Engineering (ESIE), Mechanical and Fabrication Engineering, and Engineering Operations. The division is responsible for space in all or portions of buildings 25, 25B, 44B, 46, 46A, 46B, 50A, 62, 70A, 77 complex and 79A.

The majority of Engineering's staff are matrixed to its partner divisions: ALS, AFRD, Genomics, Life Sciences, Nuclear Sciences and Physics. These matrixing arrangements vary greatly. ALS is the largest partner, with approximately 40% of Engineering staff matrixed to that division. Ongoing projects supported by Engineering include ATLAS, ICECUBE,

Supernova/Acceleration Probe (SNAP), and Transmission Electron Aberration-Corrected Microscope (TEAM).

The most significant hazards confronting Engineering personnel are from its operations in the industrial and fabrication shops located in the building 77 complex. In these work environments, the typical hazards include machining, welding, high temperature ovens and furnaces, high voltages, heavy crane hoist use, hazardous chemicals and hazardous wastewater treatment. Engineering employees also contend with hazards of sealed sources, x-rays, hazardous chemicals general electrical hazards, heavy lifting and ergonomics. The Division's ES&H program is part of the Engineering Operations Department that includes Human Resources and Business Services. The Division Safety Coordinator reports to the Division Deputy Director for Operations and assumes responsibility for the day-to-day operations of the ES&H program.

C. Description of the Appraisal Process

The objective of the MESH Review is to evaluate the Engineering Division's management of ES&H in its operations, focusing on the implementation and effectiveness of the Division's Integrated Safety Management (ISM) Plan. The MESH is a peer review that provides perspective from the research and operations community on the state of ES&H in the Division. The review team consisted of Linda Smith, team leader from Information Technology Division; Steve Blair, Facilities Division; Wayne Lukens, Chemical Sciences Division; and Michelle Flynn, Office of Contract Assurance. Engineering invited Carol Ingram of the DOE Berkeley Site Office, to observe the review. Ms. Ingram was present for interviews of the Division Director and Division Safety Coordinator

The appraisal process included a review of the documentation provided by Engineering Division and the Office of Contract Assurance: Engineering's response to the MESH questionnaire and supporting documentation, division ISM Plan, list of formal authorizations, Corrective Action Tracking System (CATS) records, agendas and minutes from safety meetings, and accident and injury data. The MESH Team conducted an opening meeting with division representatives, interviewed senior and line management and staff, and visited division workspaces.

The MESH Team interviewed the following individuals (matrix affiliation noted in parentheses):

- Kem Robinson, Division Director
- Peter Denes, Deputy Division Director, ESIE
- Alan Paterson, Deputy Division Director, Department Head, Mechanical and Fabrication Engineering
- John Freeman, Deputy Division Director, Operations
- Weyland Wong, Division Safety Coordinator
- Joan Wolter, ESIE Administrative Assistant
- Guy Pulsifer, Central Shops Manager
- David McMillan, Machinist
- Bob Shannon, Machine Shop Supervisor (88-inch cyclotron)
- Doyle Byford, Electronics Technologist (88-inch cyclotron)
- John Roller, Mechanical Technician (88-inch cyclotron)

- Alan Biocca, Control Systems Group Leader (ALS)
- Dan Columb, Mechanical Technician Superintendent (ALS)
- Tom McVeigh, Electronics Technologist (AFRD)

The MESH team visited the central machine shop in building 77 and the 88-inch cyclotron.

D. Results of the MESH Appraisal

The SRC MESH team conducted interviews of personnel on July 18 and 19, and several follow up interviews in person or via telephone the week of July 23. .

The appraisal results are organized by areas of inquiry from the MESH questionnaire, which follows the core functions of Integrated Safety Management. Findings are broken into three categories:

> Noteworthy practices – practices or conditions that are recognized for their excellence and should be considered for Lab-wide application.
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> Observations – observations indicate room for improvement. They may be practices or conditions that are not necessarily out of compliance, but could lead to non-compliance if unaddressed. Observations may also reflect practices that, with some additional level of effort, could achieve noteworthy practice status.
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> Concerns – clear cases of practices or conditions that do not comply with regulations or LBNL policy, and/or indicate inadequate management systems within the division. Concerns are deficiencies and must be corrected.

1. Work Planning

Engineering's ISM plan is a succinct description of expectations for safety, and includes a translation of the elements of ISM into five questions every Engineering employee is to ask and answer when making a decision, taking an action, or completing a task. Employees are required to complete the division's online Engineering ISM 101 course to learn the fundamentals of ISM. Safety considerations for work planning begin with the division's senior management team. Engineering conducts monthly "safety headlights" meetings consisting of the Division Director, Division Deputies, safety coordinators, human resources manager and administrative support. Departments and groups also conduct regular meetings, dedicated or inclusive to safety topics, and involve the division safety coordinators, as appropriate.

Engineering communicates ES&H issues through various mechanisms. Staff receives safety information through their line management chain, group meetings, the division's ES&H website and the Safety Corner section of Engineering News. For significant ES&H developments such as roll out of the new ISM training and badges, the Division Director and Division Deputies attended department and group meetings to personally deliver the message.

Engineering employees also receive ES&H communication from partner divisions' matrix supervisors, building managers, and safety committees. Staff matrixed to ALS described a

strong flow of safety information from the ALS, and improved synergy between the two divisions under Kem Robinson's leadership.

Noteworthy Practice: Engineering has committed resources for two safety coordinators. Depth in this critical function enhances their ability to perform root cause investigations on injuries and adverse ES&H events, and develop and implement new safety initiatives. The division is also able to perform long-term succession planning to the veteran safety coordinator.

Noteworthy Practice: Through its ongoing self-assessment activities, Engineering line and senior management recognized a gap in understanding of the core functions of ISM. In response, the division developed an on-line ISM training course, required for all employees. They translated the five core functions of ISM to language pertinent to routine staff activities, with a focus on personal responsibility. Engineering designed and produced associated ISM badges for employees to carry and serve as a constant reference and reminder of ISM. The badge also includes the name and extension of one of the division's safety coordinators.

Observation: Several supervisors in the division have an inordinately large number of direct reports. In Mechanical Engineering the Central Shops Manager has 17 direct reports, and the Mechanical Technician Superintendent at the ALS has 19. In ESIE, four individuals supervise 12-13 employees, another supervises 19, and the Deputy Director has 23 direct reports. In most of these cases, the supervisors' staff works in multiple locations and for varying partner divisions. Notable to the MESH Team was that when asked to whom they would report a safety concern, none of those questioned mentioned their Engineering Division supervisor. Such a broad span of control for some supervisors may lead to gaps in managing ES&H for staff. Under impending Lab policy on roles and responsibilities for safety, Engineering will need to formally identify work leads and ensure they receive appropriate training.

Concern: Engineering has Memoranda of Understanding (MOUs) for safety responsibilities with all but one of its partner divisions; however, these MOUs do not specify the safety responsibilities for their respective supervisors and employees.

The MOUs refer to LBNL's Regulations and Procedures Manual (RPM), Chapter 7.01, Section D, Matrixed Employees and Responsibility for Safety. The MOUs state, "Engineering Division and (host division) agree that safety responsibilities for Engineering Division employees matrixed to (host division) will be divided between home supervisor, host supervisor and employee as described in RPM 7.01, Section D with the following exceptions/deletions: None."

The first bullet of RPM Chapter 7.01 Section D states: "The employee's supervisor from the home division or department retains all health and safety responsibilities pertaining to matrixed employees, except where some of the responsibilities have been transferred to the host division or department through a formal Memorandum of Understanding (MOU) between the two organizations." The MOUs between Engineering and its partner divisions do not identify the safety responsibilities for their respective supervisors and employees; rather, they reference the RPM table of safety responsibilities that may be transferred to the host supervisor and those that must be retained by the home organization's supervisor.

Concern: As permitted by the RPM, key areas of responsibility are negotiable between the home and host organizations: personal protective equipment; administrative controls, including AHDs,

RWAs, etc.; and engineering controls for health and safety. The MESH Team identified cases where Engineering did not fully address these negotiable responsibilities with partner divisions:

1. Since March 2007, an Engineering employee matrixed to the Materials Sciences Division (MSD) has been listed as the X-ray System Supervisor (XSS), and Engineering the responsible division, for X-ray Authorization (XA)-7018. Previously, and for several years, a Material Sciences Division (MSD) employee and MSD were the XSS and responsible division of record, respectively. The Radiation Protection Group (RPG) recommended the change in XSS based on discussions with both the MSD and Engineering employees, who stated the Engineering employee was the only person using the X-ray equipment. Per EHS procedure, updating the XSS on an XA is considered minor and does not require rerouting of the XA for review and approval. However, by designating an Engineering employee as the XSS, Engineering became the responsible division for the XA and was not prompted by RPG to review and approve the XA. RPG plans to revise its procedure to address such cases in the future (see Institutional Observation/Recommendation below). Regardless, Engineering and/or its partner division should have identified both the inconsistency in documented responsibilities spanning several years and the recent administrative disconnect.

   Institutional Observation/Recommendation: When a "pen-and-ink change" of an X-ray System Supervisor also prompts a change in responsible division on an X-ray authorization (XA), RPG should re-route the XA for review and approval.

2. A recent BSO observation of machine guarding in the Building 50 Physics Division machine shop, and subsequent discussions, identified gaps in clear roles and responsibilities for engineering controls when Engineering employees are matrixed to other division spaces. In a follow-up LBNL review, in addition to machine guarding deficiencies, the inspectors also identified hoisting and rigging equipment out of calibration. Follow on discussion revealed that neither Physics nor Engineering had a full understanding of who was responsible for maintaining the equipment in question.

2. Hazard Identification and Risk Analysis

The Engineering Division uses several mechanisms to identify hazards and analyze risk. Proposals for Engineering funded and managed projects are reviewed and approved by the Division Director. The safety coordinator also reviews Engineering proposals to identify safety implications, consults with the EH&S Division liaison, as necessary, and initials the proposal to indicate the review was completed. Other division personnel such as line managers, principal investigators and project leads review projects to identify and analyze risks and develop mitigation controls. By applying ISM and the Safe Work Authorization guidance and criteria from PUB 3000 Chapter 6, the project team determines if the work requires formal authorization. If so, they consult with the division safety coordinator and ES&H liaison. Line managers task employees and are responsible for ensuring hazards are identified and mitigation controls in place. Engineering expects its line managers to maintain an awareness of work scope and take action when changes to operations or policy affect the safety envelope of their activities. Note: Engineering Division carries out a wide variety of operations, such as machine tool use, that are hazardous but fall short of requiring an AHD. Since these operations do not require an

AHD, no formal hazard analysis is currently required. However, a formal hazard analysis will be needed under the job hazard analysis (JHA) program required by 10 CFR 851.

Higher hazard operations /facilities are the UHV Cleaning and Plating Facility (UHVCPF) and the Electronics Photo Fabrication Facility. The metal fabrication tasks in Building 77's mechanical fabrication facility include welding, sheet metal working, machining and crane use. The cleaning and plating shop use large quantities of chemicals and have extensive ventilation, scrubbers and chemical berm segregation systems as well as their associated monitoring and alarm systems, specific PPE requirements, confined space, voltage and current associated with electro-polishing, chemical product handling and storage, waste handling and processing.

Engineering management also considers the aged equipment and facilities used by some of its partner divisions a potential risk to its matrixed employees.

The 2004 MESH review noted one concern under Hazard Identification and Risk Analysis. The 2007 MESH review identified continuing issues in this area.

2004 MESH Review Concern: *Hazard review of projects that do not require formal authorizations (i.e., projects with lower hazards), are not documented or reviewed by Division management. The Project/Facility Safety Review Questionnaire that was intended to screen all projects for hazards has been eliminated. The Division's policy is that line managers are responsible for the safety review of all potentially hazardous activities. However, there is little documentation that such reviews are occurring regularly and with appropriate rigor. The lack of oversight by the Division safety management group and/or EH&S subject matter experts also perpetuates the uncertainty of the hazard reviews. This concern is the same concern that was identified in the last MESH review three years ago.*

Engineering Response: *Engineering and our customer divisions regard the allocation of roles and responsibilities as itemized in RPM 7.01D and regular use of the ISM 5 action steps as sufficient and adequate to address this concern.*

2007 MESH Review Observation: While there is nothing wrong with applying RPM 7.01D to hazard identification and risk analysis, in our view, its application without supporting documentation, such as an MOU explicitly assigning ES&H roles, is insufficient.

One of the principles of ISM is "clear roles and responsibilities." RPM 7.01D alone does not provide clear roles and responsibilities for the host and home supervisors and divisions. Rather, RPM 7.01D leaves many areas of ES&H open to negotiation between the home and host supervisors. Unless these areas are clearly defined, for example by an MOU specific to the operation, confusion over the ES&H roles of the host and home divisions and supervisors can occur and has occurred in a number of instances. (See Concern under Work Planning)

At least two possible mechanisms for correcting this problem exist. First. RPM 7.01D could be rewritten to remove the negotiable roles and responsibilities (i.e. if two divisions wish to assign responsibilities differently, they could do so through an MOU). Alternatively, an MOU could be written for each operation specifically assigning responsibilities in the areas that RPM 7.01D leaves open for negotiation. This MOU could be a simple fill-in-the-blank document, but it

would be necessary to have the supervisors from each division agree who is responsible for each aspect of safety.

3. Establishment of Controls

Engineering establishes administrative controls through both formal authorization and execution of the Engineering ISM Plan. The Engineering Division has two active AHDs, one for the UHV Cleaning and Plating Facility and one for the Electronics Photo Fabrication Facility. Both of these facilities have associated fixed treatment unit EBMUD permits and waste accumulation areas. Engineering is the responsible division for three Sealed Source Authorizations, one Low Activity Source Authorization, one Radiological Work Authorization and one X-ray Authorization. For work that does not require formal authorization, division line mangers assign work to their direct reports consistent with Engineering's ISM plan and according to the particular matrix arrangement.

Noteworthy Practice: Engineering has communicated Basic Safety Expectations to all its employees. The first is to maintain a current JHQ, updating it at least annually or any time job hazards, assignments, or supervision changes. The second expectation is to complete and maintain current required ES&H training. Neither expectation is exclusive to Engineering, but the division has taken measures to assure employees remain vigilant in meeting them. The division posts overdue JHQ and training completion reports in the directorate lobby, and when training completion is overdue, supervisors and employees must meet with the Division Director to explain the circumstances.

Noteworthy Practice: Based on our interviews, new employees take the JHQ along with their supervisor. Of necessity, the JHQ is somewhat confusing for new employees, and taking it with their supervisor ensures that new employees will take the classes that they actually need and do not take unnecessary classes.

Observation: Engineering division carries out a wide variety of operations, such as machine tool use, that are hazardous but fall short of requiring an AHD. In these cases, on-the-job training (OJT) in Engineering is informal and undocumented. While there is nothing wrong with informal OJT (in fact Engineering's OJT seems to be very effective), documentation of this OJT will be required under the JHA program currently being developed.

Observation: The MESH team asked supervisors for examples of safety concerns raised by their staff. In response, the Central Shops Manager reported a case where a recent hire identified storage of metal plates as a hazard to those working in the vicinity. When questioned by the MESH team why someone in the shop has not addressed the hazard, he stated he has been aware of it for some time and other safety matters, such as enforcing use of safety glasses, have taken priority. Engineering did not enter the finding into CATS for tracking.

4. Work Performance

Engineering takes a series of measures to ensure adherence to authorized controls, beginning with completion of the JHQ and required training. Line managers and supervisors conduct

walkarounds and observations as a means of validating and confirming adherence to authorized controls and practices. Division management promotes reporting of unsafe conditions present in both Engineering and customer divisions' workspaces. The division took swift action in response to non-compliant waste management practices, informing senior Engineering management and retraining personnel. The division has two trained ERGO advocates and has reduced it recordable injuries over the past few years, from five in 2005 and three in 2006, to one year-to-date in 2007.

Noteworthy Practice: While they acknowledge improvement in this area, division management expressed concern over their staff's reluctance to report safety issues if they involve the customer. One approach the Division Director has taken to address this concern is assuming responsibility for ORPS reporting of adverse events involving his staff while working under the direction of partner divisions. His intent is to encourage Engineering employees to report such events, with minimal concern for burdening the customer with ORPS reporting and subsequent investigation. Both division safety coordinators have comprehensive root cause analysis training enabling them to guide Engineering and its customers in developing effective, sustainable improvements to prevent recurrence.

Observation: The MESH Team noticed first aid kits mounted on the wall in the Building 77 machine shop. The availability of first aid supplies may discourage reporting injuries to Health Services as required by Lab policy. The division safety coordinator noted that the presence of these kits represent legacy practices and will advise removal.

5. Feedback and Improvement

Division management is directly involved in self-assessment activities beginning with their participation in the "safety headlights" meetings. Deputies and supervisors participate in all accident/injury and ORPS-reportable event reviews, thereby enhancing their awareness of work practices and associated risks. Engineering recognizes employee initiative regarding safety and issues Safety Spot Awards for particularly notable contributions.

Noteworthy Practice: Following an ORPS-reportable electrical near miss incident, Engineering identified the cause of the event as insufficient knowledge of the mechanical technician to analyze and mitigate the electrical hazards. In response, Engineering worked with EH&S to develop ENG1001 Electrical Safety - What Everyone Needs To Know. The objective of this brief web-based training is to assure a common baseline understanding for all Engineering employees and achieve zero incidents in the future. The LBNL Electrical Safety Officer plans to incorporate elements of this new Engineering training into the Lab-wide course EHS 260, Basic Electrical Hazards and Mitigations.

Noteworthy Practice: A separate ORPS-reportable electrical safety event involving an Engineering employee prompted the division to seek improved methods for documenting multiple source Lock Out / Tag Out (LOTO) procedures. Engineering researched new LOTO software and hosted a product demonstration by the vendor for potential users including the LBNL Electrical Safety Officer, the SRC Electrical Safety Subcommittee chair, and key individuals from partner divisions ALS and NSD. Following a positive responses from attendees,

Engineering purchased the local version and EH&S ultimately purchased a version for Lab-wide use. The new software unifies the appearance of LOTO procedures, promotes the use of photographs, and facilitates documentation of multiple source LOTO procedures.